Claims

1. Inertial sensor based on the magnetic levitation of an inertial mass comprising an active magnetic bearing unit arranged in such a way as to levitate the inertial mass and characterized by the fact that it furthermore comprises additional active magnetic bearings units arranged in such a way as :
   - to control the position of said inertial mass along three independent axis.
   - to create, for any of said independent axis, restoring forces that can be oriented in any of the two directions of said independent axis.

2. Inertial sensor according to claim 1 wherein said inertial mass is a spherical or cylindrical ferromagnetic body.

3. Inertial sensor according to claim 2 comprising:
   - 6 electromagnets diametrically disposed in pairs along three orthogonal axis,
   - 6 position sensors diametrically disposed in pairs along three orthogonal axis,
   wherein said pair of electromagnets constitutes each of said active magnetic bearing units,
   wherein position of said inertial mass is computed differentially with said pairs of position sensors,
   wherein said inertial sensor is enclosed in an outside frame made of homogeneous ferromagnetic material; said outside frame constituting a magnetic shielding of said inertial sensor,
   wherein a lock-in amplifier is used for the signal conditioning of said position sensors,

wherein said outer frame of said inertial sensor is hermetically sealed in order to offer the possibility of creating and keeping vacuum inside said frame of said inertial sensor.

4. Inertial sensor according to claim 2 comprising:
- 6 vertically arranged electromagnets placed in such a way as to create forces in three orthogonal directions,
- magnetic permeable cores used to bring the magnetic field near the inertial mass and reducing magnetic losses.
- a position sensing system composed of two laser diodes and two 4-segments photodiodes orthogonally placed in a horizontal plane between the upper said electromagnets and the lower said electromagnets;
wherein the said six vertically arranged electromagnets constitutes said active magnetic bearing units;
wherein position of said inertial mass is computed differentially with said position sensing system;
wherein said inertial sensor is enclosed in an outside frame made of homogeneous ferromagnetic material; said outside frame constituting a magnetic shielding of said inertial sensor;
wherein a lock-in amplifier is used for the signal conditioning of said position sensors.
wherein said outer frame of said inertial sensor is hermetically sealed in order to offer the possibility of creating and keeping vacuum inside said frame of said inertial sensor.

5. Inertial sensor according to claim 2 comprising:
- 4 horizontally arranged electromagnets, placed in such a way as to create forces in two orthogonal directions.
- 2 vertically arranged electromagnets placed in such a way as to create forces in a direction independent of previously said two orthogonal directions.
- magnetic permeable cores used to bring the magnetic field near the inertial mass and reducing magnetic losses.

- a position sensing system composed of two laser diodes and two 4-segments photodiodes orthogonally placed in a horizontal plane between the upper electromagnet and the lower electromagnet,
wherein said horizontally and vertically arranged electromagnets constitutes said active magnetic bearing units;
wherein position of said inertial mass is computed differentially with said position sensing system;
wherein said inertial sensor is enclosed in an outside frame made of homogeneous ferromagnetic material; said outside frame constituting a magnetic shielding of said inertial sensor;
wherein a lock-in amplifier can be used for the signal conditioning of said position sensors.
wherein said outer frame of said inertial sensor is hermetically sealed in order to offer the possibility of creating and keeping vacuum inside said frame of said inertial sensor.

6. Inertial sensor according to any of the previous claims with a compensating magnet placed above said inertial mass so as to compensate for the weight of said inertial ferromagnetic mass and to lower the power consumption of said inertial sensor.

7. Use of an inertial sensor according to any of the previous claims as a three dimensional non-contact accelerometer or as a three dimensional non-contact seismometer.

8. Use of an inertial sensor according to any of the previous claims 1 to 6 as a three dimensional non-contact or tiltmeter (inclinometer).

9. Use of an inertial sensor according to any of the previous claims 1 to 6 comprising a motor function implemented by applying a rotating magnetic field to, at least, two of said electromagnetic bearing units in order to spin said inertial mass around its main axis of inertia.

10. Use of an inertial sensor according to the previous claim as a non-contact gyroscope.

11. Use of an inertial sensor according to any of claims 1 to 6 as a non contact gravimeter.